REMARKS

Claims 1-33 were presented for examination and were pending in this application. In the latest Office Action, claims 1-5 and 8-32 were rejected, and claims 6, 7, and 33 were objected to. With this amendment, claims 2, 3, 9-11, 14-16, 18, 21, 26, and 27 are amended. On the basis of the following remarks, consideration of this application and allowance of all pending claims are requested.

I. Claim Rejections: 35 U.S.C. § 112, second paragraph

Claims 2-4 and 9-28 were rejected under 35 U.S.C. § 112 as being indefinite. Specifically, the examiner asserted that the phrase "can be" rendered the claims indefinite. Although it is believed that one of skill in the art would understand the meaning of the phrase as it is used in the claims, to advance prosecution the claims have been amended to avoid the use of the phrase "can be" while not changing the scope of the claimed invention.

II. Claim Rejections: 35 U.S.C. § 103

Claims 1, 2, 5, 8-10, 13-15, 17-20, and 26-32 were rejected as obvious in view of U.S. Patent No. 5,066,952 to Koerner. As explained below, Applicants respectfully traverse this rejection.

The claimed invention as recited in the rejected claims performs digital signal processing in multiple stages. The output samples from these stages are digital signals expressed in memory segments having a finite number of bits. Expressing the digital signal in finite memory can lead to error, or noise, caused by the loss of least significant bits (i.e., "rounding off" due to truncation). To reduce this error, the claimed invention adjusts the dynamic range of an output from a processing stage. This increases the precision of the system by preserving the least significant bits in the output samples (i.e., not truncating these bits) while avoiding the loss of

most significant bits in these output samples. Because more least significant bits are retained in the output samples, the output samples contain a more accurate representation of the digital signal.

In one example to illustrate this concept, a stage in the digital signal processing may produce an output sample of "2.75." In this example, a 5-bit word width is allocated for the output samples of this stage. In conventional signal processing, this output sample might be stored as "00101" in a dynamic range of [-8,7.5]. Because of this dynamic range, the least significant bit is discarded and the signal is thus degraded because the value is rounded to "2.5." But rather than discard the least significant bit, the dynamic range of the output sample can instead be decreased to [-4,3.75]. In this dynamic range, the output sample "2.75" is represented as "01011," without any loss of information. Decreasing the dynamic range in which the output sample is stored thus increased the precision in the calculation by avoiding losing least significant bits in an intermediate result. The cited art does not address this problem, as it is not directed to increasing precision in a multiple stage digital signal processor.

Instead, Koerner describes a data acquisition system in which an analog signal is sampled to generate a digital signal. Generally, Koerner is concerned with the problem of sampling a wide enough range of analog signals for applications like radar systems, where the input analog signals can vary widely. Koerner refers to the range of amplitudes of input systems that the data acquisition system must be able to handle as the "input dynamic range requirements" of the system. Koerner attempts to make his data acquisition system handle a larger "dynamic range" of input signals by making a sampling system that is nonlinear. Koerner thus "compresses" the received input analog signal using a nonlinear sampling technique. With reference to Koerner's FIG. 2, Koerner samples an analog input analog signal using a nonlinear A/D converter (10).

This compressed sampled signal is then decompressed by a mapping ROM 26, which then passes the sampled signal to the buffer memory 28, through a scale shifter, and then to a digital signal processing block 32.

A. Dynamic Range of a Digital Signal From an Output Stage of the DSP

As explained, the claimed invention reduces error due to lost information when the output values of one or more stages in a digital signal processing system are truncated due to bit width limitations. Rather than losing this information, the claimed invention adjusts the dynamic range so that the output values can be represented with more precision. In this way, at least some of the least significant bits can be preserved for processing in subsequent stages as long as the most significant bit would not be lost when shifting the dynamic range.

Koerner is not directed at maintaining precision during digital signal processing. For this reason, Koerner does not adjust the dynamic range of the outputs of a stage of a digital signal processor. Rather, any adjustment to the signal taught by Koerner is done before any digital signal processing is performed. This is evident from Koerner's FIG. 2, in which all adjusting to the received signal is just preprocessing for the digital signal processing block. Koerner does not describe anything that happens to the signal once it is passed to the digital signal processing block. Therefore, Koerner cannot disclose or suggest this claimed limitation.

In making the rejection, the examiner cited the portion of Koerner's Abstract that explains: "The data decompression and scaling arrangement can decompress previously compressed digital signals and limit the digital data width of such signals in systems which have input dynamic range requirements greater than their output resolution requirements." But as explained above, when Koerner mentions the "input dynamic range requirements," Koerner is referring to the range of amplitudes of the possible analog signals received by the data

acquisition system. Koerner is not referring to the dynamic range used to represent a digital signal. Koerner is therefore not suggesting adjusting the dynamic range of a digital signal.

The examiner further cited Koerner at col. 3, lines 31-44. But again, Koerner is just mentioning "dynamic range" in the context of the received analog signal. As Koerner explains, the selection of the ratios between the resistor values determines how much compression is achieved and thus how much of a "dynamic range" of amplitudes the data acquisition system can handle. This has nothing to do with adjusting the dynamic range of a digital signal in the context of the claimed invention.

Lastly, the examiner cited col. 4, lines 12-21 and 40-57; however, this passage merely describes preprocessing in which the received signal has been decompressed and the signal is scaled. Importantly, the scaling is done before the signal is ever passed to the digital signal processing block. Because any scaling is done before the digital signal processing, the scaling done to the signal does not suggest adjusting the dynamic range of an output of a stage of the digital signal processing.

Accordingly, Koerner does not disclose or suggest the claimed adjusting of the dynamic range of digital signals output from a stage in a digital signal processor. Each of the claims are therefore patentable over Koerner.

B. Multiple Stages

The examiner acknowledged that Koerner does not disclose the claimed "multiple stages." To cure this acknowledged deficiency in Koerner, the examiner asserted that Koerner's buffer memory, scale shifter, and digital signal processing "are capable of providing the claimed features." But Applicants note that in the claimed invention the "multiple stages" are stages of a digital signal processing system. The dynamic range adjustment is performed after one or more

of the multiple stages of the digital signal processing. In Koerner, however, the digital signal processing is contained wholly within the "digital signal processing" block (element 32), so any stages of the digital signal processing would be inside that block. Moreover, any dynamic range adjustment in Koerner is performed before the signal is passed to the digital signal processing. Therefore, Koerner does not describe doing anything with respect to outputs from stages of the digital signal processing, much less performing dynamic range adjustment thereto.

C. Motivation to Modify Koerner

The only justification provided for modifying the Koerner reference was: "It would have been obvious to a person having ordinary skill in the art at the time the invention was made to design the claimed invention according to Koerner's teaching because the device is a system for dynamic range digital processing as claimed." This justification is inadequate. In essence, the justification appears to be that it was obvious to modify Koerner to achieve the claimed invention because Koerner's device is like the claimed invention. But this argument merely assumes the conclusion, and it fails to explain any motivation or reasoning in which a skilled person would seek to modify Koerner.

Koerner is directed to a different problem than the claimed invention. Specifically, Koerner is not concerned with errors that may result when rounding off the outputs of stages in a digital signal processing system. In fact, Koerner is primarily concerned with applications that "have input dynamic range requirements greater than their output resolution requirements." The input dynamic range requirements referred to in Koerner are to allow a data acquisition system receive a wide range of amplitudes of a received analog signal. In contrast, the claimed invention is concerned with increasing precision of a digital signal being processed in a digital processing system, thereby avoiding errors or noise in the result of the digital signal processing.

Where Koerner does describe scaling a digital number, this scaling is performed only to eliminate the least significant bits that are uncertain due to the digitizing. As Koerner explains, "Not all m bits stored in the buffer memory registers are significant; the actual number of significant bits (those which contain data greater than the digitizing noise) is somewhat less than n. . . . The digital signal processing algorithm thus operates only on the significant bits in the data." (Koerner, col. 4, lines 45-59.) Koerner is thus contrasted with the claimed invention, which adjusts dynamic range to include more least significant bits. In essence, Koerner drops least significant bits that are too precise given the digitizing uncertainty, whereas the claimed invention includes more of the least significant bits to increase the precision of the digital signal.

Accordingly, there would have been no motivation to modify Koerner to achieve the claimed invention, even if doing so were possible.

D. Means-Plus-Function Limitations

Claims 29 and 30 recite a device that includes several elements recited in means-plus-function form. Applicants respectfully traverse this rejection because the examiner has not established a prima facie case of obviousness. Specifically, although the claims contain means-plus-function language, they were rejected without a construction of that language as mandated by 35 U.S.C. § 112, sixth paragraph. Moreover, no case of obviousness could be made. Properly construed in light of and consistent with the specification, claims 29 and 30 are patentable over Koerner.

Whether a claim is anticipated or made obvious by the prior art necessarily depends on the scope of the claimed subject matter; therefore, any patentability determination must necessarily begin with a correct interpretation of the claims. The interpretation of means-plus-function language in a claim is controlled by statute. Under § 112, sixth paragraph, a claimed

means for performing a function is construed to cover the corresponding structure described in the specification for performing that function, and any equivalents thereof. Applying the principle that claims are given their "broadest reasonable interpretation" during prosecution, means-plus-function language is given its broadest reasonable interpretation possible within the constraints of § 112. *In re Donaldson Co.*, 16 F.3d 1189, 1194-95 (Fed. Cir. 1994) (in banc).

When presented with means-plus-function language, the PTO may not interpret the language as *any* "means for" performing that "function" because such an interpretation would be broader than allowed by statute. *Donaldson*, 16 F.3d at 1195 ("The PTO is required by statute to look to [the] specification and construe the 'means' language . . . as limited to the corresponding structure disclosed in the specification and equivalents thereof."). Rather, an examiner must first construe the means-plus-function limitations in the claims according to the sixth paragraph of § 112. The examiner must then show that the prior art describes a structure that is the same as or equivalent to the structure described in the specification corresponding to the claimed means-plus-function. MPEP 2182. Moreover, the MPEP explains that this is the examiner's initial burden when rejecting a claim having means-plus-function limitations:

> [I]f a prior art reference teaches identity of function to that specified in a claim, then under *Donaldson* an examiner carries the initial burden of proof for showing that the prior art structure or step is the same as or equivalent to the structure, material, or acts described in the specification which has been identified as corresponding to the claimed means or step plus function.

MPEP 2182 (emphasis in original). Because the Office Action lacks any such showing, no prima facie case of invalidity has been made.

Here, in fact, such a showing could not be made. Koerner does not describe a structure that is the same as or equivalent to the structures for performing the claimed means-plus-function

limitations disclosed in the present application. Accordingly, claims 23 and 30 are patentable over the cited references for this additional reason.

E. DSL Modem

Claims 30-33 recite a DSL modem having a multiple stage digital signal processor that implements the dynamic range adjustment on one or more output samples of one or more stages of the processor. Although these claims were rejected as obvious in view of Koerner, the Office Action contains no reference to any disclosure or suggestion in Koerner to implement the claimed dynamic range adjustment in a DSL modem. Indeed, neither Koerner nor the Office Action itself contains any mention of a DSL modem whatsoever.

It is the burden of the Patent Office when rejecting a claim to explain how a prior art reference is being applied to each of the limitations of each rejected claim. MPEP 707.5 ("When such prior art is cited, its pertinence should be explained.") Given that the Office Action has failed to address important aspects of the claims, the rejection of claims 30-33 cannot be maintained.

III. Allowable Subject Matter

Applicants note with appreciation the examiner's acknowledgement that claims 3, 4, 6, 7, 11, 12, 16, 21-25, and 33 recite patentable subject matter. These claims have not been rewritten in independent form because the base claims from which these claims depend are patentable for the reasons set forth herein.

IV. Summary

Based on the foregoing, the application is in condition for allowance of all claims, and a Notice of Allowance is respectfully requested. If the examiner believes for any reason direct

contact would help advance the prosecution of this case to allowance, the examiner is encouraged to telephone the undersigned at the number given below.

Respectfully submitted,

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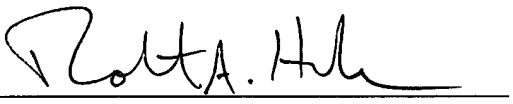
Dated: April 18, 2005

By: 

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